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# IMPACTS OF DRINKING MAGNETIZED WATER ON SOME SEMEN AND BLOOD PARAMETERS OF RABBIT BUCKS UNDER WINTER AND SUMMER CONDITION IN EGYPT

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**ABSTRACT:** The study was conducted to evaluate the effects of magnetized water (2000 Gauss) and season on semen and blood constituents in rabbit bucks. A total number of 32 New Zealand White (NZW) rabbit bucks were used in the experimental work during winter and summer seasons (16 in each). In each season animals were divided into 2 sub-groups (8 bucks in each). One sub group received magnetized water (MW) and the other received non magnetized water (NMW). Semen was collected weekly for 8 weeks using an artificial vagina. Reaction time (RT) was recorded during semen collection. Blood was collected and some common parameters were assayed. Semen was evaluated for ejaculate volume, mass motility, progressive motility, sperm concentration, live, dead and abnormal spermatozoa. Results showed that electrical conductivity, dissolved oxygen content, salinity, particularly sodium and calcium contents, and pH value in MW increased as compared to NMW. Ejaculate volume, mass motility, progressive motility, reaction time and sperm concentration were not affected by season, while live, dead and abnormal spermatozoa were affected ($P \leq 0.001$). Bucks consumed MW showed significantly improved ($P \leq 0.001$) physical semen characteristics in terms of increasing mass motility, progressive motility, sperm concentration, live spermatozoa and ejaculate volume as well as reaction time compared to NMW. Dead and abnormal spermatozoa were significantly ($P \leq 0.001$) lower in bucks received MW than in NMW. Consumption of MW led to an increase of red blood cells (RBC), hemoglobin (Hb) and hematocrit (HCT) as compared to NMW. However RBC, Hb and Platelet count (PLT) were considerably higher ($P \leq 0.001$) in winter than in summer. In general as, magnetic treatment improved water quality, physical semen characteristics and blood constituents in rabbit bucks.

**Key words:** Magnetic water, rabbit buck, semen characteristics.

## INTRODUCTION

Demand for animal proteins is increasing as world population increases (**Abd El-Moniem *et al.*, 2016**). Rabbit is a good potential source as a solution to fulfill demand for animal proteins (**Daader *et al.*, 2016**). Rabbits if compared to other livestock animals are characterized by early sexual maturity, high prolificacy, relatively short gestation period, short gestation interval, rapid growth, more efficient feed conversion and low rearing cost (**Cheeke *et al.*, 1982**). Rabbit meat is nearly white, finely grained, palatable, mild flavored, low cholesterol content, high-quality protein content, and contains a high percentage of minerals than other meat types (**Heba *et al.*, 2016**). Therefore, rabbit production might play a considerable role in solving the problem of meat shortage in Egypt (**Seleem *et al.*, 2007**).

Unfortunately, hot summer environment has negative effects on productive and reproductive performance of farm animals and rabbits in special (**Rasooli *et al.*, 2010; Attia *et al.*, 2013; Gallo *et al.*, 2014; Daader *et al.*, 2016**). Under these conditions drinking good quality water becomes of great necessity for better animal production level, as drinking poor water quality

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negatively affected animal performance and welfare (**Bassuny *et al.*, 2004 and Attia *et al.*, 2013**).

In majority of small rabbit farms, especially in desert regions good quality water is not always available. Investigators are commonly concerned with improving water quality and in turn better animal productive level.

Subjecting water to magnets was found to improve water quality (**Yacout *et al.*, 2015**), due to considerable changes in pH, total dissolved solids, total hardness, conductivity, salinity, dissolved oxygen, , minerals, organic matter and total count of bacteria (**Shaban and Azab, 2017**). Drinking MW caused increased milk yield in dairy cows (**Lin and Yotvat, 1990**) and dairy ewes (**Shamsaldain and Al-Rawee, 2012**). In additions to improving fertility in buck (**Attia *et al.*, 2015**), weight gain in geese (**El-Hanoun *et al.*, 2017**) and egg production and hatchability in turkey (**Shaban and Azab, 2017**).

It could be mentioned that studies concerned with treating rabbits with MW are lacking. Consequently, this study was designed to evaluate the effects of drinking MW on physiological and reproductive activity in New Zealand White rabbit bucks under winter and summer conditions.

## MATERIALS AND METHODS

The present study was carried out in private Rabbitry farm and laboratories of Animal Production Department, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, during the period from June 2016 to March 2017.

### Animal and Management

The study was carried out on 32 New Zealand White rabbit bucks aged 4 to 4.5 months age and 2750±48.3g average body weight.

### Experimental Design

All animals were reared under similar environmental conditions and fed *ad libitum* on a commercial pelleted rabbit ration with a composition and chemical analysis shown in Table 1. All rabbit groups were housed in a naturally ventilated building and kept in individual Italian wire galvanized cages (60 × 55 × 40 cm), equipped with manual feeders and automatic drinkers. Continuous access to fresh water was provided from automatic nipple drinkers.

The experiment lasted for 16 weeks from June to September 2016 during summer season (16 bucks) and 16 weeks from December 2016 to March 2017 during winter season (16 bucks). In each season, bucks were divided into two sub groups (8 bucks in each). One group was provided with MW and the other group was kept untreated with tap water was used (control, NMW).

Magnetized tap water was obtained by exposing water to a magnetic field of approximately 2000 gauss using permanent system equipment producing magnetic field. The strength of the magnet was measured by a gauss meter before the initiation and after the termination of the experiment. Measurements of water composition either magnetized and non-magnetized are shown in Table 2.

### Bucks Libido and Semen Collection And Assessment

During 4 weeks of the experimental work, bucks were trained for semen collection and adaptation to the experiment conditions according to **IRRG (2005)**. Semen was collected and 96 ejaculates were obtained during 8 weeks of the experiment period as 24 ejaculates per treatment.

Reaction time (sec), as an indication of libido, was the time elapsed from the introduction of the female to the male's cage till ejaculation was recorded. Semen was collected once a week using an artificial vagina maintained at 45–46°C and ejaculate volume (EV), mass motility (MM), progressive motility (PM), sperm concentration (SC), live (LS), dead (DS) and abnormal spermatozoa (AS) were assessed.

The ejaculate volume for each buck was recorded after removal of the gel mass. Immediately after collection, semen was kept at 37°C in a water bath in order to be evaluated. Mass motility was determined using one drop of fresh semen, which were placed on a warmed slide. Mass motility from at least three fields was examined under a light microscope, at 10 × and assessed from 0 to 100%.

**Table 1. Composition and calculated chemical analysis of the basal diet**

| Ingredient (%) | (%) | Calculated chemical analysis | (%) |
|---|---|---|---|
| **Clover hay** | 30.0 | Crude protein | 17.75 |
| **Wheat bran** | 32.0 | Crude fat | 2.29 |
| **Barley grain** | 19.0 | Crude fiber | 14.36 |
| **Soybean meal** | 14.0 | Calcium | 0.94 |
| **Molasses** | 3.0 | Methionine | 0.30 |
| **Limestone** | 1.30 | Methionine + Cysteine | 0.65 |
| **Vitam. and Min. premix*** | 0.30 | Lysine | 1.04 |
| **Sodium chloride** | 0.30 | Arginine | 1.44 |
| **Anti-coccids** | 0.10 | DE kcal/kg diet | 2555.00 |
| **Total** | 100 | | |

* Each 3 Kg of the Vitam. and Min. premix contains: Vitam. A. 6000000 IU, Vitam.D3 900000 IU; Vitam. E. 40000 mg; Vitam. K3 2000 mg; Vitam. B1 2000 mg; Vitam. B2 4000 mg; Vitam. B6 2000 mg;Vitam. B12 10 mg; biotin 50mg; coline chloride 25000 mg; pantothenic acid 1000 mg; nicotinic acid 50000 mg; folic acid 3000 mg; Mn, 8500 mg; Zn, 50000 mg; Fe, 5000 mg; Cu, 500 mg; Se, 100 mg; I 200 mg and Co, 100 mg and complete to 3.0 Kg by calcium carbonate.

** According to **NRC (1977)**.

Progressive linear motility was determined using two drops of fresh semen with two drops of saline solution, which were placed on a warmed slide and covered with a cover slip (20×20 mm). Progressive motility from at least three fields was examined under a light microscope, at 40 × and assessed from 0 to 100%.

A weak eosin solution was used at a rate of 1:99 before counting the cells, for evaluation of sperm concentration ($\times 10^6$/ml) according to **Smith and Mayer (1955)** by the improved Neubauer haemocytometer slide (GmbH+Co., Brandstwiete 4, 2000 Hamburg 11, Germany). Assessment of live and abnormal spermatozoa was performed using an eosin-nigrosine blue staining mixture (**Blom, 1950**).

The percentage of live, dead and abnormal spermatozoa was determined by using stains that penetrate cells with damaged membranes. Normal live spermatozoa was not stained by the eosin stain and appeared white in color, whereas dead spermatozoa was stained by eosin and appeared pinkish in color due to loss of membrane integrity.

Normal sperm had an oval head with a long tail. Abnormal spermatozoa had a head, midpiece or tail defects, *e.g.* a large or misshapen head or a crooked or double tail. Total live spermatozoa were calculated by multiplying ejaculate volume by sperm concentration by livability percentage. Total normal spermatozoa were calculated by multiplying ejaculate volume by sperm concentration by normal sperm percentage.

## Blood Assessment

At the end of the experimental period in each season, blood samples were collected from slaughtered rabbits (4 in each group) in two clean sterile tubes for each animal immediately after slaughtering. Blood samples were collected in heparinized tubes to obtain whole blood samples to determine hematological parameters, hemoglobin concentration using cyano-methemoglobin technique (**Mitruka and Rawnsley, 1977**).

White blood cells (WBC), red blood cells (RBC), hemoglobin (Hb), hematocrit (HCT), platelet count (PLT), total protein (TP), Albumin (Alb) and Globulin (Glob) were assessed.

The RBCs count was determined by using hemocytometer according to **Perkins (2009)** and using a light microscope at 400x magnification. hemoglobin (Hb) (%) was analyzed colorimetrically according to **Van Kampen and Zillstra (1983)**. Hematocrit (Ht%) was measured by capillary tubes, the opposite end of the tubes were sealed, and then centrifuged for 10 minutes at 3,000 rpm according to **Bauer (1970)**. Total protein, albumin, globulin were determined according to **Weichselbaum (1946) and Domas *et al.* (1971)**, respectively.

## Statistical Analysis

The data were statistically analyzed with **SAS (1999)** according to the following model:

$$Y_{ijk} = \mu + T_i + S_j + TS_{ij} + e_{ijk}$$

Where, $\mu$ is the overall mean, Ti is the treatment of magnetized water (i=1, 2), Sj is the season of year (j=1, 2), $TS_{ij}$ is the interaction effect of magnetized water and the season of year, $e_{ijk}$ is the random error term. The significant differences of ANOVA were tested using Duncan Multiple Range Test (**Duncan, 1955**).

# RESULTS AND DISCUSSION

## Magnetic Water Properties

Analyses of MW showed remarkable changes in its properties as compared to NMW, in terms of increasing electrical conductivity, dissolved oxygen content, salinity, particularly sodium and calcium contents, and pH value. On the other hand, chloride decreased in MW comparing with NMW (Table 2). Similar findings were reported on MW by several authors (**Mahmoud, 2013; Attia *et al.*, 2015; Yacout *et al.*, 2015; El-Hanoun *et al.*, 2017; El-Ratel and Fouda, 2017**).

Physically, exposure of water to magnetic field changes water properties which becomes more energized, active, soft and high pH toward slight alkaline and free of germs which fulfill water quality for poultry requirements (**Mg-Therapy, 2000**). Magnetized water causes the hydrogen-oxygen bond angle within the water molecule to be reduced from 104 to 103 degrees. This in turn causes the water molecule to cluster together in groups of 6-7 rather than 10-12. The smaller cluster leads to better absorption of water across cell walls (**Verma, 2011). Ibrahim (2006)** reported that increasing electric conductivity of MW may be due to the effect of magnetic field on formation of hydrogen bonds of water molecule, leading to changes in water conformation, which may be responsible for variations in conductivity and dielectric contents.

Some researchers reported that magnetic treatment affect water properties such as light absorbance, pH, surface tension (**Cho and Lee, 2005**) and amount of oxygen dissolved in water (**Harakawa *et al.*, 2005**). Normal water has a pH level of about 7, whereas magnetic water can reach 9.2 following the exposure to 7000 (Gauss) strength magnet for a long period of time (**Lam, 2001**).

## Main Effect of Water Type on Semen Characteristics in Bucks

Bucks received MW improved significantly ($P\leq0.001$) all physical semen characteristics in terms of increasing mass motility, progressive motility, sperm concentration, live sperm and ejaculate volume as compared to NMW treated bucks (Table 3).

Dead and abnormal spermatozoa were significantly ($P\leq0.001$) lower in buck's received MW than in NMW groups (Table 3). **Al-Daraji and Aziz (2003)** revealed that the quality and quantity of semen of roosters that received magnetic water were significantly better than those of controls.

The positive impact of MW on semen quality was established in rabbit bucks (**Attia *et al.*, 2015; El-Ratel and Fouda, 2017**), Holstein bulls (**Al-Nueimi and Al-Badry, 2014**), male geese (**El-Hanoun *et al.*, 2017**) and human (**Shaban and Azab, 2017**).

Results regarding the libido of rabbit bucks indicated significant ($P<0.001$) reduction in reaction time (RT) in bucks received MW than in NMW groups (Table 4). The present values of RT are similar to that reported on bucks, being between ≤0.5 and 1 min for good RT (**Hultsch *et al.*, 2002**), indicating good sexual desire in rabbit males drinking MW.

**Table 2. Analysis of water types used in the experiment**

| Parameter | Unit | tap water | Magnetized water |
|---|---|---|---|
| **pH** | - | 7.35 | 7.88 |
| **Conductivity** | (ms/cm) | 690 | 736 |
| **Salinity** | (mg/L) | 320 | 350 |
| **Dissolved oxygen** | (ppm) | 6.5 | 7.2 |
| **Sodium (Na+)** | (ppm) | 6.8 | 7.4 |
| **Potassium (K+)** | (ppm) | 1.2 | 1.6 |
| **Calcium (Ca2+)** | (mg/l) | 115.7 | 122.8 |
| **Magnesium (Mg2+)** | (mg/l) | 114.2 | 118.1 |
| **Chloride (Cl–)** | (ppm) | 3.2 | 1.6 |
| **Carbonate (CO3–)** | (ppm) | 3.7 | 4.3 |
| **Bicarbonate (HCO3)** | (ppm) | 22.5 | 26.2 |

**Table 3. Effect of drinking magnetized water in winter and summer season on semen characters of bucks**

| Item | | EV (ml) | MM (%) | PM (%) | SC $\times 10^6$ | LS (%) | DS (%) | AS (%) |
|---|---|---|---|---|---|---|---|---|
| **Main effect of water type** | | ** | *** | *** | *** | *** | *** | *** |
| Magnetized water | | $0.57^a$ | $76.15^a$ | $75.46^a$ | $483.02^a$ | $84.99^a$ | $14.94^b$ | $10.39^b$ |
| | | ±0.09 | ±8.89 | ±8.23 | ±89.39 | ±3.62 | ±3.72 | ±1.73 |
| Un magnetized water | | $0.48^b$ | $63.36^b$ | $63.28^b$ | $359.6^b$ | $78.34^b$ | $21.66^a$ | $13.65^a$ |
| | | ±0.11 | ±10.32 | ±11.28 | ±78.7 | ±5.24 | ±5.32 | ±2.153 |
| **Main effect of season** | | NS | NS | NS | NS | *** | *** | *** |
| Summer | | 0.50 | 67.95 | 68.12 | 420.51 | $79.12^b$ | $20.9^a$ | $13.11^a$ |
| | | ±0.11 | ±11.6 | ±12.39 | ±102.49 | ±5.66 | ±5.68 | ±2.56 |
| Winter | | 0.55 | 71.6 | 70.63 | 422.13 | $84.2^a$ | $15.7^b$ | $10.9^b$ |
| | | ±0.11 | ±11.6 | ±10.8 | ±108.64 | ±4.37 | ±4.39 | ±2.05 |
| **Interaction effect** | | NS | NS | NS | NS | NS | NS | NS |
| **Summer** | Magnetized water | 0.55 | 72.30 | 73.22 | 462.5 | 82.5 | 17.5 | 11.6 |
| | | ±0.12 | ±11.04 | ±11.18 | ±102.87 | ±2.86 | ±2.86 | ±1.73 |
| | Un magnetized water | 0.55 | 63.6 | 63.02 | 378.5 | 75.8 | 24.31 | 14.64 |
| | | ±0.09 | ±11.09 | ±12.02 | ±88.87 | ±5.88 | ±5.89 | ±2.4 |
| **Winter** | Magnetized water | 0.6 | 80 | 77.7 | 503.5 | 87.5 | 12.36 | 9.2 |
| | | ±0.051 | ±3.7 | ±2.95 | ±74.67 | ±2.37 | ±2.49 | ±0.47 |
| | Un magnetized water | 0.55 | 63.13 | 63.54 | 340.7 | 80.9 | 19 | 12.6 |
| | | ±0.12 | ±10.25 | ±11.32 | ±67.57 | ±2.98 | ±3.14 | ±4.44 |

a, b-values with different superscripts within same treatments and columns are significantly different ($P \leq 0.05$). Ejaculate volume (EV), mass motility (MM), progressive motility (PM), sperm concentration (SC), live spermatozoa (LS), dead spermatozoa (DS), abnormal spermatozoa (AS).

**Table 4. Effect of drinking magnetized water in winter and summer seasons on reaction time of bucks**

| Item | Main effect of water type *** | | Main effect of season NS | | Interaction effect NS | | | |
|---|---|---|---|---|---|---|---|---|
| | MW | NMW | Summer | Winter | Summer | | Winter | |
| | | | | | MW | NMW | MW | NMW |
| **RT(Sec)** | $9.841^{b}$ ±2.1 | $17.29^{a}$ ±4.27 | 14.6±5.16 | 12.54±4.8 | 11.1±1.97 | 18.07±5.03 | 8.6±1.4 | 16.5±3.5 |

a, b– values with different superscripts within same treatments and columns are significantly different (P≤0.05). Reaction time (RT).

Drinking MW showed more improvement in total sexual libido, in term of decreasing RT from 30.80 to 19.30 s, followed by increasing testosterone concentration (1.55 *vs*. 1.93) (**El-Ratel and Fouda, 2017**), as reported **by Attia *et al*. (2015)** in rabbit bucks, **Al-Nueimi and Al-Badry (2014)** in Holstein bulls and **El-Hanoun *et al.* (2017)** in geese.

In this respect, MW can increase the ability of the body to produce hormones like sexual hormones (**Al-Nueimi *et al*., 2015**), that in turn improves semen characteristics (**Alfonso *et al*., 2006**). The improvement in semen quality of bucks that consumed magnetized water could be attributed to the positive impact of magnetic water on antioxidant enzymes, lipid peroxidation biomarkers and immunity which improve body tolerance to pollutants and harmful effects of free radicals (**Rommerts, 1990**).

**El-Hanoun *et al.* (2017)** reported that the observed improvement in semen quality traits may be due to magnetic water's circulation of blood and oxygen, which improves general body health and performance.

On contrary, **Ozlem *et al.* (2017)** reported that exposure of bucks to electromagnetic field (EMF) had harmful effects on semen quality.

## Main Effect of Season on Semen Characteristics in Bucks

Ejaculate volume, mass motility, progressive motility, sperm concentration and reaction time were not affected significantly by season (Table 3 and 4). **Blume *et al.* (1977) and Rastimeshin (1979)** reported that season of the year had no significant effects on semen ejaculate volume of rabbit bucks. Similarly, **Abou-Warda (1994)** found insignificant effects of season of the year on sperm cell concentration.

Live, dead and abnormal spermatozoa were affected (P≤0.001) by season and were fever of winter compared to summer (Table 3). The seasonal effect on sperm abnormalities and dead sperm corresponds with the findings of **Pingel and Abou El-Ezz (1981), El-Sherbiny (1987), Finzi *et al*. (1995), Marai *et al*. (1996,1998), Daader *et al*. (1997)**. Similarly, **Ain-Baziz *et al*. (2012)** found that the rate of total anomalies of sperm cells was significantly increased in summer period (18.8%, P<0.001).

The increase in percentage of sperm abnormalities in summer may be due to the adverse influence of high temperature on spermatogenesis, which could lead to high percentages of deformed spermatozoa (**Zeidan, 1989**).

Ejaculate volume, mass motility, progressive motility, reaction time, sperm concentration, live spermatozoa, dead and abnormal sperms were not significantly affected by water type and season interaction (Table 3).

It is worth mentioning here that although the above mentioned values regarding water type and season interaction effect, statistically did not reach a significant level, from the biological point of view the results obtained could not be neglected.

## Effect of Drinking Magnetized Water and Season on Blood Components of Bucks

For better assessment of rabbit performance while evaluating the effect of any desired treatment, analyzing the hematological parameters becomes important. It is helpful in evaluation of rabbit health situation.

When assessing rabbit diseases also, knowledge of the reference values of haematologic and biochemical parameters is helpful in the evaluation of rabbit health situations and provides important information for clinicians (**Lepitzki and Woolf, 1991; Silva *et al.,* 2005; Chineke *et al.,* 2006; Melillo, 2007; Archetti *et al.,* 2008**). However, haematological and biochemical parameters analysed are influenced by many factors such as breed, age, gender, feeding, environmental conditions, disorders, stress, pregnancy and cardiac rhythm (**Chineke *et al.,* 2006; Melillo, 2007; Jeklova *et al.,* 2009; Abdel-Azeem *et al.,* 2010**).

The values of arithmetic means and standard deviation of means of hematologic parameters and statistical comparisons between different treatments are presented in Tables 5 and 6.

Table 5 presents the impact of water type on WBC, RBC, Hb, HCT and PLT. There were significant effect ($P \leq 0.001$) on RBC, Hb and HCT. But WBC and PLT were not affected significantly by water type.

The same trend was obtained on bulls (**Al-Nueimi *et al.*, 2015**) and goats (**Yacout *et al.*, 2015**) who recorded that animals treated with MW showed a significant increases in red blood cells count, packed cell volume and hemoglobin concentration.

Increasing the RBC's count may be attributed to increasing the intensity of water processor magnetically to that the magnetic field works on iron attract in the blood and then connect the blood in larger quantities to the area causing an increase of RBC's number and Hgb and therefore carried more oxygen to cells (**Rokicki, 2006**).

An increase in lymphocyte, RBCs and Hb also concurred with improved semen quality, showing an improvement in the health status of bucks consumed magnetized water (**Attia *et al.*, 2015**).

Results in Table 5 show also that red blood cells, hemoglobin and Platelet count were affected significantly ($P \leq 0.001$) by season, most of parameters are higher in winter compared to summer. The same results were obtained by **Okab *et al.* (2008)** who reported that heat stress induced the reduction in RBC counts, Hb and PCV, where the overall means of these parameters tended to decline during summer season. **Ashour (2001) and Gad *et al.* (1995)** found that hematological parameters were the highest in winter, retained during autumn and spring and were the lowest in summer.

In contrary white blood cells and hematocrit were not affected significantly by season. White blood cells, red blood cells, hemoglobin and hematocrit were affected significantly ($P \leq 0.001$) by the water type and season interaction (Table 5). This probably means that the positive response of these blood parameters to water magnetization depends mainly on season of the year.

In addition, it has been denoted that WBC count rise in rabbits rarely indicates an infection; it generally varies due to various stress factors and blood collection methods (**Silva *et al.*, 2005; Melillo, 2007; Jenkins, 2008**). In one study **(Fuentes and Newgren, 2008)**, it was reported that WBC values of the rabbits kept alone were higher than in rabbits fed together in groups.

Most of the blood parameters determined in this study and presented in Table 5 and 6 were within the range of reference values reported for rabbits in previous studies (**Hewitt *et al.*, 1989; Silva *et al.*, 2005; Elmas *et al.*, 2006; Melillo, 2007**).

## Effect of Drinking Magnetized Water and Season on Blood Proteins in Bucks

Table 6 presents the effect of water type on total protein, albumin and globulin. It appeared that there were no significant effects of water type on these blood parameters.

Total protein, albumin and globulin were not affected significantly by season. **Marai *et al.* (2008, 2009)**, did not observe any effects of season or changes in ambient temperature on hematological indices of sheep.

Total protein, albumin and globulin were not affected significantly by the interaction between type water and season (Table 6).

Under the condition of this work, it appeared that water magnetization improved rabbits bucks semen characteristics and finally their fertility. In addition to this, the parallel positive effect of MW on some blood parameters especially RBC, s many explain the beneficial effect of such a technique on rabbit bucks fertility through the improvement of health status of bucks.

**Table 5. Effect of water type and season on blood components in bucks**

| **Item** | | **WBC ($\times10^3/mm^3$)** | **RBC ($\times10^6/mm^3$)** | **HB (g/dl)** | **HCT (%)** | **PLT ($\times10^3/mm^3$)** |
|---|---|---|---|---|---|---|
| **Main effect of water type** | | NS | *** | *** | *** | NS |
| **MW** | | 5.97±2.99 | $5.41^a$±0.729 | 11.28 $^a$±1.484 | 33.6 $^a$±5.47 | 173.167±83 |
| **NMW** | | 7.66±2.388 | 3.83 $^b$±1.66 | 7.97 $^b$±2.96 | 22.8 $^b$±7.98 | 207.50±115.26 |
| **Main effect of season** | | NS | *** | *** | NS | ** |
| **Summer** | | 7.51±2.25 | 3.8 $^b$±1.66 | 8.44 $^b$±3.54 | 30.6±3.45 | 124.8 $^b$±40.55 |
| **Winter** | | 6.13±3.18 | $5.41^a$±0.72 | 10.8 $^a$±1.2 | 25.8±11.61 | 255.8 $^a$±94.56 |
| **Interaction effect** | | * | *** | *** | *** | NS |
| **Summer** | **MW** | 8.05±2.32 | 2.43±0.48 | 5.53±1.33 | 29.27±4.64 | 102.67±5.03 |
| | **NMW** | 6.97±2.36 | 5.2±1.03 | 11.23±0.45 | 31.95±1.23 | 147±51.11 |
| **Winter** | **MW** | 3.09±2.02 | 5.2±1.01 | 10.43±1.64 | 16.33±3.91 | 243.7±47.85 |
| | **NMW** | 8.4±2.54 | 5.6±0.27 | 11.35±2.22 | 35.23±7.81 | 268±140.08 |

a, b– values with different superscript within similar treatments and columns are significantly different (P≤0.05).White blood cells (WBC), Red blood cells (RBC) , Hemoglobin (Hb), Hematocrit (HCT)and Platelet count (PLT).

**Table 6. Effect of water type and season on blood proteins in bucks**

| **Item** | | **TP (g/dl)** | **Alb(g/dl)** | **Glob(g/dl)** | **Alb/Glob (%)** |
|---|---|---|---|---|---|
| **Main effect of water type** | | NS | NS | NS | NS |
| MW | | 4.79 ±0.85 | 2.64±0.36 | 2.33±0.64 | 1.21±0.43 |
| NMW | | 5.4±1.08 | 3.08±0.58 | 2.32±0.8 | 1.49±0.78 |
| **Main effect of season** | | NS | NS | NS | NS |
| Summer | | 5.21 ±1.18 | 2.76±0.61 | 2.44±0.64 | 1.15±0.17 |
| Winter | | 5.16±0.78 | 2.96±0.43 | 2.21±0.78 | 1.56±0.85 |
| **Interaction effect** | | NS | NS | NS | NS |
| Summer | MW | 5.24±1.1 | 2.64±0.56 | 2.59±0.61 | 1.03±0.15 |
| | NMW | 5.17±1.5 | 2.87±0.76 | 2.3±0.76 | 1.26±0.9 |
| Winter | MW | 4.7±0.65 | 2.63±0.12 | 2.07±0.68 | 1.39±0.58 |
| | NMW | 5.63±0.66 | 3.28±0.35 | 2.34±1.01 | 1.16±1.73 |

a, b-values with different superscript within similar treatments and columns are significantly different (P≤0.05). Total protein (TP), Albumin (Alb) and Globulin (Glob).

It is of interest to note the beneficial effect of MW on both semen and blood of bucks during summer. The question remains to be answered is what is expected to be if this work is carried out using higher power of magnet, longer experimental internal and higher number of animals.

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# تأثير شرب الماء الممغنط على بعض معايير السائل المنوى والدم فى ذكور الأرانب تحت ظروف الشتاء والصيف فى مصر

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أجريت هذه الدراسة لتقييم آثار المياه الممغنطة (٢٠٠ جاوس) والموسم على السائل المنوي و معايير الدم في ذكور الأرانب، تم استخدام ٣٢ ذكر أرنب نيوزيلندي أبيض (NZW) خلال فصلي الشتاء والصيف (١٦ في كل منهما)، تم تقسيم الأرانب في كل موسم إلى مجموعتين (٨ أرانب في كل مجموعة). تناولت المجموعة الأولى المياه الممغنطة (MW) والثانية تناولت المياه غير الممغنطة (NMW)، تم جمع السائل المنوي أسبوعيا لمدة ٨ أسابيع باستخدام المهبل الاصطناعي، تم تسجيل الوقت اللازم لقذف السائل المنوى (RT) عند جمع السائل المنوي، تم جمع عينات الدم وتم تحليل بعض المعايير الشائعة، تم تقييم السائل المنوي لحجم القذفة، الحركة الجماعية، الحركة الفردية، تركيز الحيوانات المنوية، الحيوانات المنوية، نسبة الحيوانات المنوية الحية والميتة والغير طبيعية، أظهرت النتائج أن درجة التوصيل الكهربى ومحتوى الماء من الأكسجين المذاب والملوحة (لا سيما محتويات الصوديوم والكالسيوم) وقيمة الرقم الهيدروجيني في الماء الممغنط زادت مقارنة مع الماء الغير ممغنط، لم يتأثر حجم القذف والحركية الجماعية والحركية الفردية والوقت اللازم لقذف السائل المنوى وتركيز الحيوانات المنوية بالموسم، في حين تأثرت نسبة الحيوانات المنوية الحية والميتة والغير طبيعية بالموسم، أظهرت الأرانب المستهلكة للماء الممغنط تحسنا ملحوظا فى خصائص السائل المنوي من حيث زيادة الحركة الجماعية و الحركية الفردية و تركيز الحيوانات المنوية ونسبة الحيوانات المنوية الحية وحجم القذف وكذلك الوقت اللازم لقذف السائل المنوى مقارنة مع الأرانب التى لم تستهلك مياه ممغنطة، الماء الممغنط أدى إلى زيادة خلايا الدم الحمراء (RBC)، الهيموجلوبين (Hb) والهيماتوكريت (HCT) مقارنة بالماء الغير ممغنط، كان عدد كرات الدم الحمراء والـ Hb والصفائح الدموية (PLT) أعلى في فصل الشتاء عن فصل الصيف، نستخلص من ذلك أن المعاملة بالماء الممغنط عملت على تحسين جودة المياه و خصائص السائل المنوى و مكونات الدم فى ذكور الأرانب.

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